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ABSTRACT

An elementary account of the instructional systems approach and new forms of education technology, and the use of each in federal government programs, is set down. The educational technology described includes programed instruction, teaching machines, computer-assisted instruction, educational television, and simulation. The emphasis is on the use of technology by the government rather than on explaining what each form is. A brief annotated bibliography is appended. (JK)

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Instructional Systems and Technology: An Introduction to the Field and Its Use in Federal Training

Training Systems and Technology Series: No. I

EM 010 150

U.S. CIVIL SERVICE COMMISSION
BUREAU OF TRAINING

PAMPHLET T–11

Instructional Systems and Technology: An Introduction to the Field and Its Use in Federal Training

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INTRODUCTION

This paper is the first in a series dealing with the various aspects of technology and the instructional systems approach to training. It provides a brief description of the approach and explains some of the new techniques which have become popular with the advent of sophisticated audio-visual equipment and programmed instruction.

Several Federal agencies were contacted so that specific applications of the approach and uses for new equipment might be cited. These agencies were:

- Civil Service Commission
- Department of Defense
  - Department of the Air Force
  - Department of the Army
  - Department of the Navy
- Department of Health, Education, and Welfare
  - Food and Drug Administration
  - National Institutes of Health
  - Social Security Administration
- Department of Justice
  - Federal Bureau of Investigation
- Department of State
  - Agency for International Development
- Department of Transportation
  - Federal Aviation Agency
- Department of the Treasury
  - Internal Revenue Service

As the reader moves through the paper he will find that many examples cited come from the military sector of Federal training. Although there is substantial use of new technology and approaches in civilian training programs throughout government, perhaps the most unique and exciting advances have been made in training for military personnel. An explanation for this phenomenon lies in the military's critical need for quick, efficient training for vast numbers of trainees, who constitute an ever changing trainee population.

The need for training in the Armed Services is of a broad and increasing scope. As new equipment is added or as new procedures are established, the number and kind of training programs grows. Such an atmosphere of need coupled with change and growth is highly conducive to experimentation and implementation of new methods.

Throughout the paper examples are cited which are in various stages of planning and completion. These examples indicate the increasing interest which this new approach is stimulating in Federal training circles. More and more agencies are beginning to work with new technology and plan programs which implement new approaches.

Subsequent papers dealing with specific aspects of training systems will provide more details about these projects. In all cases, more information about a specific project is available from the training office of the sponsoring agency.

Scope and Definitions

In the field of training and education, the word "technology" is becoming more and more popular. To many in this field, "technology" connotes "hardware" in the form of mechanical teaching devices and audio-visual equipment. However, "technology" will be used with a different connotation here.

In Webster's dictionary, "technology" is defined as "the systematic treatment of an art." Education may well have the need to become a "systematically treated art", as it experiences the pressures of too many students and too few qualified instructors to adequately handle them. It is because of this need that the new terms and new definitions used here have come into being. In a new area "the questions are many; the answers few. The questions are not often clearly stated and the few available answers tend to be equivocal."[1] However, well defined terms can eliminate some of this confusion and, therefore, the following definitions will be used throughout this and subsequent papers.

"A training system is a series of interrelated, interacting, precisely controlled learning experiences that are designed to achieve specific training objectives; and organized into a unified, dynamic whole which is responsive and adaptive to the individual trainee while fulfilling specific job-relevant training criteria."[2]

For Programmed Instruction the paper will use a definition given by Wilbur Schramm, who said, "By programmed instruction I mean the kind of learning experience in which a program takes the place of a tutor for the student, and leads him through a set of specified behaviors designed and sequenced to make it more probable that he will behave in a given desired way in the future. . ."[3]

The term "hardware" will be used in referring to mechanical teaching machines, and audio-visual equipment such as video-tape recorders, projectors, tape recorders and computer setups.

"Software" will be used to describe items necessary for the use of and/or to be fed into hardware. This includes, for example, programs, used in CAI and in teaching machines, and the objectives set down for the training and evaluation materials.

Instructional Systems Approach

The Instructional Systems Approach is a systematic way of developing training courses. Although the approach can be described in a variety of ways, these seven steps characterize it.

1. Determination of need (job and task analysis);
2. Stating learner performance objectives and conditions;
3. Preparing criterion measures of these performances;
4. Identifying incoming student characteristics;
5. Selecting content and media to achieve the performance objectives;
6. Providing learning experiences designed to achieve the performance objectives in the minimum amount of time with the minimum expenditure at the designated level of proficiency;
7. Using information from measures of student progress to evaluate the objectives and instructional procedures.[4]

Each of these statements indicates the necessity to *know* and to know *exactly*. In a systematic approach to program development, there is no room for *hoping* a course will produce desired results—results which are not defined when development begins. The key to a systematic approach in training lies in *knowing* what are the desired performance objectives and developing a course which provides what is necessary to have *all* students meet all the desired performance objectives.

As Robert Mager stated in his *Preparing Instructional Objectives*, "A builder does not select his materials or specify a schedule for construction until he has his blueprints (objectives) before him."[5] Objectives help select material and specify a schedule for construction, but more specifically they satisfy three needs found in training courses.[6]

1. There is a need to know exactly what the trainee will be expected to do as a *direct* result of the training.
2. There is a need to know exactly the conditions under which the trainee will perform.
3. There is a need to know exactly what the standards of performance will be.

When objectives are written, there are several criteria which help an instructor evaluate them. Mager suggests asking the following questions to test the clarity and the completeness of stated objectives:[7]

1. Does the statement describe what the learner will be doing when he is demonstrating that he has reached the objective?
2. Does the statement describe the important conditions (given or restrictions or both) under which the learner will be expected to demonstrate his competence?
3. Does the statement indicate how the learner will be evaluated? Does it describe at least the lower limit of acceptable performance?

In addition to preparing objectives, evaluation of the entire package is an integral part of systematically developing a course. All aspects of the system are appraised and evaluated for validity. Criterion tests are administered to

evaluate training objectives, individual lessons, the complete system, and to follow the system after it has been implemented in the training room. However, the need for sound objectives arises again in the area of evaluation. Mager reminds the reader that "When clearly defined goals are lacking, it is impossible to evaluate a course or program efficiently."[8]

With the integration of job analysis, objectives and thorough and meaningful evaluation, the training system becomes operative; but a training system is not static. "A training system is never a finished product; rather it is a continuing process for meeting the differing and changing needs of the individual trainee."[9] The systems approach to training can be used on a large or a small scale, for one course or for an entire curriculum. Examples of both of these applications can be found in new programs being developed in the Federal sector.

The new Federal Law Enforcement Training Center, for example, will have an entire curriculum developed through the use of the systems approach. *A Systems Approach to Training*, published by the Civil Service Commission and the Bureau of the Budget, describes the project in detail but only a summary of the program's high points will be provided here. The Center is a joint project of 19 agencies with law enforcement functions. Essentially the trainees will come from those functions which require that the law enforcement officer carry firearms. This involves several police functions including Park Police, Park Rangers, Indian Police in the Bureau of Indian Affairs, Border Patrolmen, White House Police and various investigative functions such as the Federal Marshals, agents from the Immigration Service, the Bureau of Narcotics and Dangerous Drugs, the Bureau of Customs, and Alcohol and Tobacco Tax Investigators. Training for the Secret Service will also be conducted by the Center.[10]

The Center, which is scheduled to open in Fiscal Year 1973, will offer a full curriculum for the training of recruits as well as experienced law enforcement officers. Course outlines, developed through the use of job task analysis, are already prepared. Each outline gives specific course objectives and suggested media for use in various parts of the course. The curriculum for each type of officer has been structured on a basis of course priority; that is, officers will receive the courses in a predetermined order in their training program. Each officer in a particular curriculum will receive the same set of courses in the same order. (For further information about the Center, contact Edward Pinney, Interagency Coordination Section, Room 2F03, Bureau of Training, Civil Service Commission, Washington, D.C., telephone 632–5647.)

The Internal Revenue Service is also using systems concepts in course development and is developing, both in-house and through contractors, a week-long workshop in the systems approach. The workshop will trace the steps in systematic course development and will offer the student exercises in determining course objectives and evaluation procedures. The course is being offered to IRS training personnel both from the central office and the field. The workshop is part of a plan to employ the systems approach on a nationwide basis for IRS training activities. (Mr. James Everett, IRS Training Center, Crystal Plaza, 2221 Jefferson Davis Highway, Room 403, Arlington, Virginia 22202, telephone 161–2456, is an excellent source of information about IRS programs in the instructional systems area.)

The Department of Defense, with its huge training need, is especially interested in implementing the systems approach in its programs. For example, the Army, which has a long-term project of re-evaluation and restructuring its training programs is using the systematic method. Its Office of Civilian Personnel is offering a workshop in the approach at various field installations which is designed to acquaint all Army training officers with the concepts and procedures involved in using a systems approach to developing training. The following page is the guideline used by one installation, the Army Security Agency Training Center at Fort Devens, Massachusetts, in its development of courses. It traces the steps in the instructional systems approach and indicates the flow of steps, as well as their relationship to one another.[11] The Department of the Navy is also using the systems approach in several ways. It now requires that all courses be developed with a set of detailed instructional objectives. It is developing one entire course in depth, applying not only the steps outlined

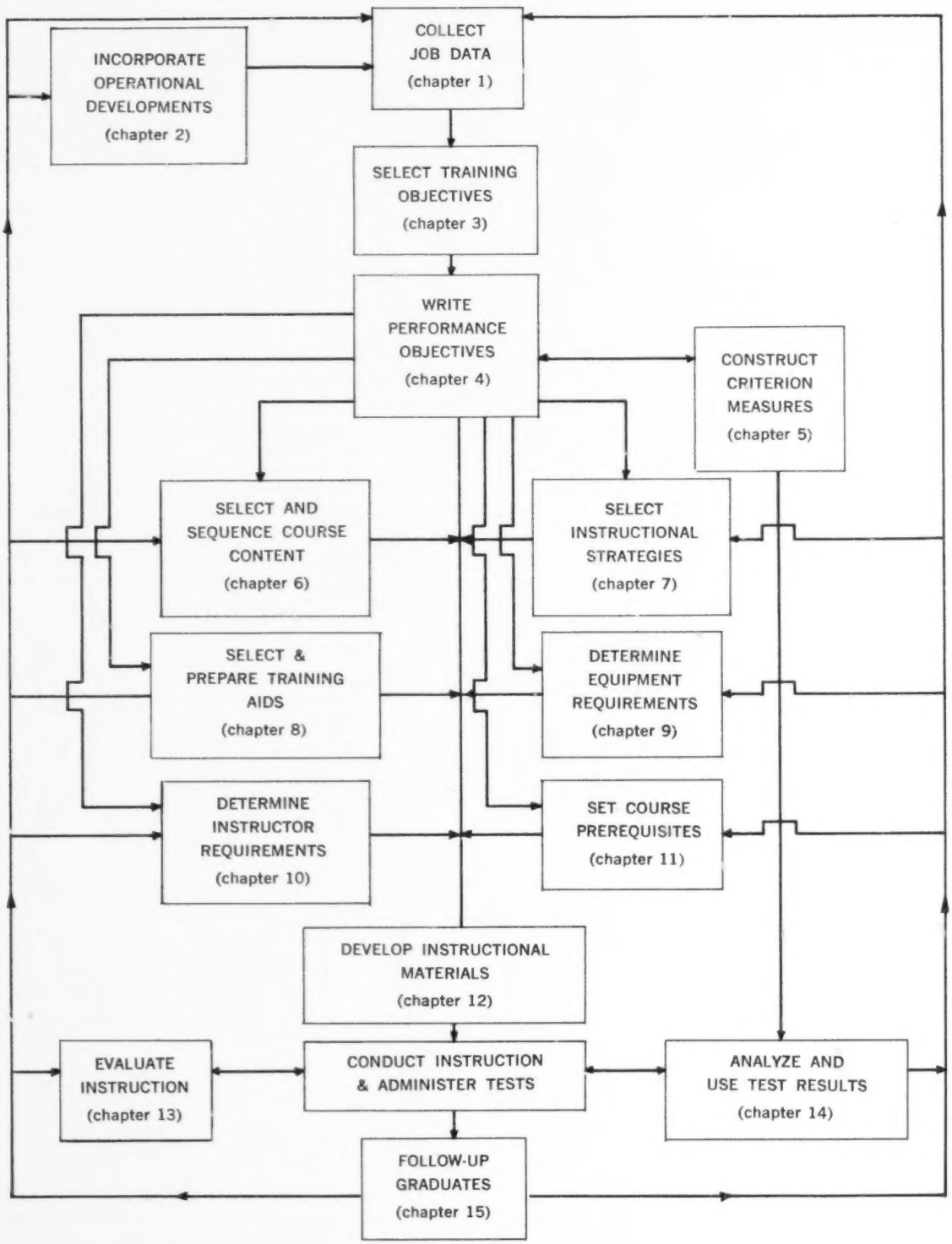

COLLECT JOB DATA (chapter 1)
INCORPORATE OPERATIONAL DEVELOPMENTS (chapter 2)
SELECT TRAINING OBJECTIVES (chapter 3)
WRITE PERFORMANCE OBJECTIVES (chapter 4)
CONSTRUCT CRITERION MEASURES (chapter 5)
SELECT AND SEQUENCE COURSE CONTENT (chapter 6)
SELECT INSTRUCTIONAL STRATEGIES (chapter 7)
SELECT & PREPARE TRAINING AIDS (chapter 8)
DETERMINE EQUIPMENT REQUIREMENTS (chapter 9)
DETERMINE INSTRUCTOR REQUIREMENTS (chapter 10)
SET COURSE PREREQUISITES (chapter 11)
DEVELOP INSTRUCTIONAL MATERIALS (chapter 12)
EVALUATE INSTRUCTION (chapter 13)
CONDUCT INSTRUCTION & ADMINISTER TESTS
ANALYZE AND USE TEST RESULTS (chapter 14)
FOLLOW-UP GRADUATES (chapter 15)

FIGURE 1. THE DEVELOPMENT AND VALIDATION OF INSTRUCTIONAL SYSTEMS

above as part of the systems approach but extending the approach to include such variables as facilities, location of training, etc.

In general, the Navy has found the systems approach most effective in developing and programming technical or "fact" courses, although it has a wide range of programmed courses dealing with more theoretical subjects such as "How to Study", "The Fighting Man's Code", and "The Enlisted Man."[12]

The Navy's broadest application of the systems approach has been in the technical training area. The need for a new course arose when the Navy adopted a new torpedo in its arsenal of weapons. The requirements for teaching the maintenance of the torpedo did not fit into the torpedoman's course being offered and the Department saw a need for a revised course. The course is being redeveloped after a job task analysis and a statement of course objectives based on the analysis. The redevelopment project hopes to determine how, in a specific situation, one can take advantage of programmed instruction and its methods in all situations. (Lawrence Mann, Bureau of Naval Personnel, Room 3070, Arlington Navy Annex, Arlington, Virginia, telephone OX4–3321, is working closely with the torpedoman's course, as well as with other Navy efforts in this area.)

Like the Navy and the Army, the Department of the Air Force is implementing the systems approach in its technical training programs. Some 11 courses have been developed using the approach and combining various programmed instructional and audio-visual methods of presentation. Like the other services, the Air Force has found the approach most effective in the development of courses in their technical training area. (The Training Devices and Instructional Technology Division, Department of the Air Force, Room 4D237, Pentagon, Washington, D.C. 20301, can supply further information on these programs.)

Programmed Instruction

Programmed instruction (PI) is an application of the systems approach to training because it requires the writer to go through the steps of the instructional systems approach to develop it. A program is characterized by thorough planning and structuring of material. It is:

(a) an ordered sequence of stimulus items
(b) to each of which a student responds in some specified way
(c) his responses being reinforced by immediate knowledge of results
(d) so that he moves by small steps
(e) from what he knows, by a process of successively closer approximation toward what he is supposed to learn from the program.[13]

It is used in a wide variety of curriculums from languages to mathematics and philosophy. It is the method used in such devices as the Autotutor and computer assisted instruction systems. Programmed courses are also found in correspondence schools and in bookstores for use by average consumers. When it is used as the method for teaching correspondence study courses, PI has a special advantage in that the student need not fill out lessons and mail them to a central office for review and correction. The feedback supplied by the program provides the student with knowledge of his progress and it does it immediately, whereas ordinarily, lessons may not be returned to him for a week or more.

In such cases, a test is administered to the student upon completion of the course to measure student achievement. One of the problems with PI is that often it has been associated with hardware, through the ignorance of the unwary and the efforts of competitive manufacturers.

Perhaps, Gilbert's first rule for "getting done the immediate job of programming" brings out the essence of this problem. He says, "If you don't have a gadget called a teaching machine, don't get one. Don't buy one; don't borrow one; don't steal one. If you have such a gadget, get rid of it. Don't give it away, for someone else might use it. This is a most practical rule, based on empirical facts from considerable observation. If you begin with a device of any kind, you will try to develop the teaching program to fit that device."[14] In other words, develop programs and *then* find media that strengthen the programs. In a training system, "the media merely make information available, they do not teach."[15] A U.S. Navy study in the use of automated teaching determined that,

"If someone is primarily interested in constructing automatic teaching devices, he should first find or construct a good program and try to improve it by experimenting with devices. In this way both the program and the device will be improved. In view of the present state of the teaching machine art, it is bound to be more fruitful to modify devices to present programs more effectively than to modify programs to fit the restrictions of a device."[16]

Gilbert states, thinking of PI after thinking of hardware, is putting the proverbial "cart before the horse." Material administered by these "programmed teaching machines" is nothing more than a paper program put into a plastic or metal dispenser! A mechanical device does not improve the quality of a program, but often it makes a program seem "more scientific" to both the student and the instructor who feels that he is really on top of new developments. Several agencies mentioned in the following pages as large users of PI adopted the hardware approach several years ago and have, for the most part, returned to the paper and pencil program as being just as effective and less costly.

This is not to say that teaching machines have no merit other than as gimmicks but, for the beginning user of PI, machines offer a world of metal and colored buttons which he is not often equipped to evaluate. It is then that he needs to be careful about the validity of the programs and the machines he wants to buy, and he should seek advice about the relative merits of using the device as opposed to using a paper and pencil program.

Through the usual trials and errors of using new techniques, PI has found wide spread use in Government. In its paper and pencil forms it is, in fact, the most widely used application of the systems approach to training. Agencies have developed their own programs and employed readily available programmed packages in areas such as listening, English grammar, and several types of mathematics.

The FBI uses programmed instruction texts as well as mechanical teaching devices and is training several employees as programmers to develop programmed courses in-house for the FBI Training Center. (Contact Mr. William Mooney, FBI Training Division, Room 632, Old Post Office Building, 12th and Pennsylvania Avenues N.W., Washington, D.C. 20251, for further information on FBI use of PI.)

The Department of Defense is the largest Federal user of programmed instruction, developed both in-house and by contract. The Army uses some programmed instruction in 560 out of 845 military occupational specialty courses; the Navy uses it in 575 technical training courses. Air Force figures are comparable. The Department has found PI to fill a critical need for training because it allows students to progress at their own rates and it frees instructors from delivering routine lectures and exercises, as many of them have been programmed.

The Navy, in its interest in PI, has developed a three week course, offered at San Diego and Great Lakes, which teaches PI to its field level people. These employees join programming teams which are assigned to a particular training center. The team is comprised of a programmer, a typist, an illustrator and three technical matter specialists (radar technicians, for example) who are instructors in various training areas. The technical specialists are also graduates of the programming course and work with the programmers to develop programs at the Center. (Lawrence Mann, Bureau of Naval Personnel, Room 3070, Arlington Navy Annex, Arlington, Virginia, telephone OX4–3321, can supply detailed information about the PI team concept and the programmer's training.)

The Forest Service has found that PI fills much the same need in its training programs as it fills for DOD. The Service's employees are scattered over all parts of the Nation and a large training staff would be required to develop and administer a standard curriculum of courses in the various training centers. PI has offered a method of uniform and effective teaching. Instructors need not develop their own courses to fill the curriculum, thus eliminating the risk of having each center teaching a program slightly different from the other centers. PI has also decreased the time required for completion of many courses. Among these courses are an "Orientation for New Federal Employees" which is a paper programmed text coordinated with a set of color slides, and an "Orientation to the Planning Programming Budgeting System", which consists of a pro-

grammed textbook and workbook. (Mr. Norman Gibbard, Forest Service, Room 907, 1621 Kent Street, Arlington, Virginia, telephone 557–4852, can be contacted for more information.)

The Internal Revenue Service at its National Training Center in Arlington, Virginia, has developed a novel course using the techniques of programmed instruction. In response to a greater need for courses in tax law, the Center sought to develop the course to meet the increasing demand. The course in tax law was redeveloped using algorithms, a mathematical term for a rule or procedure for solving problems, to teach the various laws and principles needed by trainees on the job.

In using algorithms, the student is first presented with a general question. To find the answer to that question, he moves through a succession of more specific questions until he reaches the solution to his original problem. The following page is an algorithm from one of the IRS training manuals, *Algorithms for the 50 Most-Asked Taxpayer Questions.* Although it is a simple algorithm, all the algorithms in the manual are of similar construction, but vary in length and complexity. Algorithms have been used by mathematicians for centuries and in recent times the term has taken on new meaning through the application of algorithms in computer programming. Through following an algorithm similar to the one following, the tax law student moves through a series of maneuvers to solve a problem, in such a manner as the computer. Working through the following example is the most effective way for the reader to acquaint himself with learning through algorithms. (See page 9 for contact.)

Teaching Machines

Paper programmed instruction is the first of many types of self-instructional devices. These programmed texts are the simplest to operate and the cheapest to develop as they require no equipment other than the text itself and a pencil to administer. There are on the market, however, many teaching devices which employ programmed instruction but administer the instruction through a mechanical device which has the following characteristics:[17]

1. A display by which the program is presented
2. A response panel which the learner uses in forming his responses
3. A confirming mechanism which provides the learner with information as to the correctness of his response
4. A reinforcement mechanism which provides the impetus for further operation of the device.

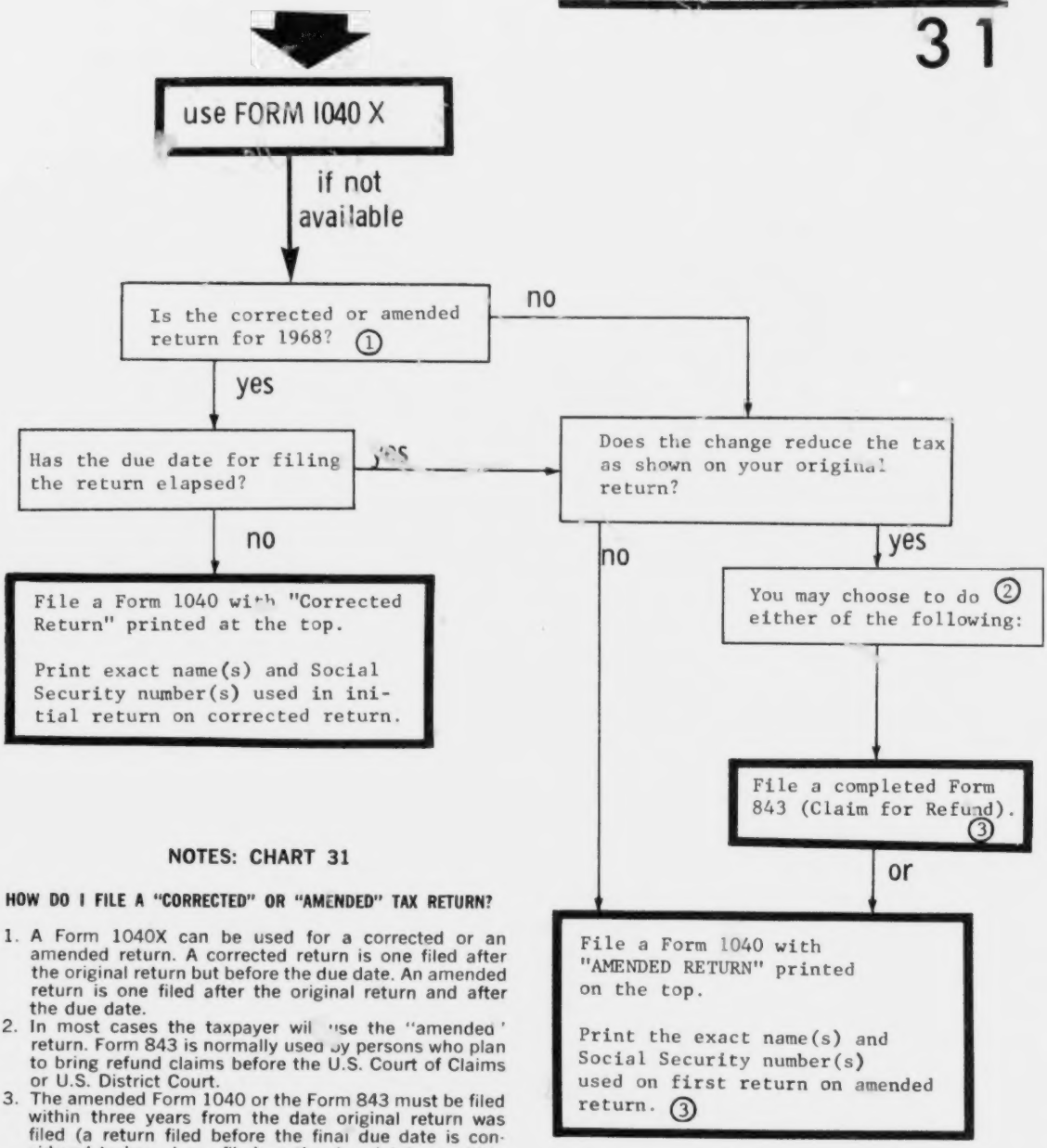
In some devices, 3 and 4 are combined.

Teaching machines come in a variety of sizes and degrees of sophistication ranging from simple devices where the student studies a single frame, makes a response and advances to the next frame by his own action to computer-assisted instruction where a computer presents a frame, the student makes a response and, on the basis of that response, the machine determines which frame of the program will be presented next. But "despite great variation in complexity and special features, all of the devices that are currently called teaching machines represent some form of variation on what can be called the tutorial or Socratic method of teaching. That is, they present the individual student with programs of questions and answers, problems to be solved or exercises to be performed. In addition, however, they always provide some type of automatic feedback or correction to the student so that he is immediately aware of his progress at each step and given a basis for correcting his errors."[18]

Although teaching machines were quite popular several years ago, their use in Federal programs has decreased. The most popular device used now is the EDEX and EDEX-type system which supplies immediate feedback on students' progress to the instructor. It is designed to present programmed instruction to reach given learning objectives. Active student participation is included and information is presented audio-visually. At certain key points in the program, multiple-choice questions are asked. The student selects his answer and indicates it on one of four buttons (A,B,C,D) on his responder. His choice is displayed on the instructor's console in two forms. First, there are four meters, one for each possible choice (A,B,C,D) which reflect the percentage of the

HOW DO I FILE AN "AMENDED" OR "CORRECTED" TAX RETURN ?

31


use FORM 1040 X
if not available
Is the corrected or amended return for 1968? ①
no
yes
Has the due date for filing the return elapsed?
yes
Does the change reduce the tax as shown on your original return?
no
yes
File a Form 1040 with "Corrected Return" printed at the top.
Print exact name(s) and Social Security number(s) used in initial return on corrected return.
You may choose to do ② either of the following:
File a completed Form 843 (Claim for Refund). ③
or
File a Form 1040 with "AMENDED RETURN" printed on the top.
Print the exact name(s) and Social Security number(s) used on first return on amended return. ③

NOTES: CHART 31

HOW DO I FILE A "CORRECTED" OR "AMENDED" TAX RETURN?

1. A Form 1040X can be used for a corrected or an amended return. A corrected return is one filed after the original return but before the due date. An amended return is one filed after the original return and after the due date.
2. In most cases the taxpayer will use the "amended" return. Form 843 is normally used by persons who plan to bring refund claims before the U.S. Court of Claims or U.S. District Court.
3. The amended Form 1040 or the Form 843 must be filed within three years from the date original return was filed (a return filed before the final due date is considered to have been filed on the due date), or within two years from the time the tax was paid, whichever is later.

* If you receive an additional W-2 or 1099 after filing your return, follow the procedures on this chart.

group selecting the correct answer. The instructor can tell immediately how well the class is performing and stop the program if further instruction is needed. Second are the student counters which provide the instructor with a cumulative score for each student, indicating how well each student is progressing. The system can be used with a variety of training methods including practice exercises, live instruction, individual instruction, films, etc.

The EDEX system has found use in both the Internal Revenue Service and at the Federal Aviation Administration Academy in Oklahoma City.

The Department of Defense has made wide use of EDEX and EDEX-type training equipment in its basic training courses because of the equipment's capability to provide immediate feedback to the instructor, and its ability to present programmed presentations.

The National Institutes of Health, HEW, also use teaching machines in some of their training programs. The device, known as the Autotutor, has been used in both managerial and clerical training. "Introduction to PERT", "Improving your Punctuation", "Improving Your Writing", and "Introduction to Computer Mathematics" are several of the courses which have been presented to employees as packaged programmed courses administered to the trainee through use of the machine. (Mr. Robert Philleo, Training Division, Room B1B01, Building 36, National Institutes of Health, Washington, D.C. 20014, handles NIH Autotutor programs.)

Computer Assisted Instruction (CAI)

In the previous section, computers were mentioned as the most sophisticated form of teaching machine; however, they are being used primarily in experimental programs because of the tremendous cost involved in developing, debugging, and administering CAI. Computer Assisted Instruction involves student inter-action with the machine through his responses to programmed lessons presented to him. The machine determines from these responses what parts of the lesson should next be presented to the student. Computers, in administering teaching programs, have the ability to move students to advanced parts of the lesson, to move them within the same level of ability all through the lesson, or to supply remedial questions to bring a slow student up to the desired level of achievement.

As interest in CAI develops, many new ways are found to use machinery with a maximum of economy. One such development is the time-sharing concept whereby "many users share virtually simultaneous access to a single large computer."[19] With this system, student consoles are hooked to a central data channel which feeds responses into the central machine and carries questions back to students. The time-sharing concept saves users the cost of renting or leasing their own equipment. It requires only that they install a hook-up with the central computer facility and student consoles.

Still another concept in the use of CAI is the teletype computer hook-up. Although quite similar to the time-sharing idea, students receive questions typed out on an ordinary teletype machine. Students type their responses into the machine and they are transmitted to a central receiver and then fed into the computer, which, based on each student's response, chooses the appropriate next question from its memory bank and sends it to the student's teletype sender-receiver. Whatever the hook-up with the computer, however, the basic principles of programmed instruction lie behind every CAI system. The lessons presented to students have been programmed first on paper then in computer language and fed into the machine. Questions are presented in single frames and a response to one question determines the next question appearing before the student.

In training situations, computers have also been used in programs of student testing and for information storage and retrieval, a capacity in which the computer acts much like a library. All of these uses indicate the computer's place in the age of technology, but "we must find out if it is also the sign of the age of education technology. Can it revolutionize education or can it only revolutionize the fringes: the testing, the record keeping, the library?"[20]

Because of the tremendous expense involved in developing and administering computer assisted instruction, it has been used on a limited scale in the Federal sector. Several projects

can be cited, however, which employ CAI in training.

Three projects are being carried out at the U.S. Naval Academy. The first of these, is a joint project of the Office of Education, HEW, and the Department of the Navy. Three multimedia courses are being developed by civilian contractors and are being tested at the U.S. Naval Academy. The courses (Economics, developed by Sterling Institute; Physics, developed by Westinghouse Learning Corporation; and Leadership, developed by the New York Institute of Technology) make optimum use of CAI but also incorporate such media as audio presentations, movie and slide presentation television, standard texts, and lecture and laboratory sessions. The media used in each course are chosen according to each curriculum's peculiar characteristics and needs. (Dr. Richard B. Otte, U.S. Office of Education, 400 Maryland Avenue, S.W., Room 3033, Washington, D.C. 20202, telephone 963–4827, is the OE coordinator for the Naval Academy CAI project.)

A second CAI project uses a computer-teletype arrangement similar to those described earlier in this paper. The third project uses the IBM 1500 Instructional System which allows the student to work with the computer through a push-button response system or through a typewriter which can receive responses or give student questions or homework. The system also uses an image projector for automatic display of text-referenced visual material. Programmed class materials are presented on a cathode ray tube (CRT) which gives a visual presentation very similar to that of a commercial television.

The Department of the Air Force, because of its large investment in both training and computer equipment, has also become interested in using CAI in its training programs. One of the Department's efforts in this area involves using CAI to teach computer operators their tasks. The course is being developed by the Air Force in cooperation with the Systems Development Corporation in Santa Monica, California. Through the time-sharing hook-ups of SDC, parts of the course are fed from California to Sheppard AFB, the test site, for testing and review by Air Force personnel. The training will teach operators through a programmed CAI format and will include some hands-on exercises on the computer directed by the program. Several Air Force training personnel are working with SDC and will, upon completion of the operator course, be able to construct CAI programs in-house for the Department.

The second course being planned for development is in the military personnel area. The Air Force uses a computerized personnel information system which is used in air base personnel offices. The goal of the new course is to teach this automated system, instructing students about the design and use of the system by using CAI. The course is being accomplished in-house by Air Force personnel now being trained in CAI techniques. The implementation date for the new program is September 1969.

Two courses are currently being developed for the training of intelligence personnel. The first of these courses is a CAI formated course designed to teach intelligence analysts the language, format and procedure for querying the stored intelligence data base. The second intelligence course will be used in the Armed Forces Air Intelligence Training Center at Lowry AFB. The facility will use a CAI formated course to recreate for intelligence personnel the type of situations they will encounter in their duties in the field.

Air Force training personnel are also investigating such areas as the maximum numbers of users that can be accomodated at any one time on a CAI network and the best uses of the time-sharing concept. The bulk of this investigation is being conducted through the facilities at Rome AFB, New York, in conjunction with several local colleges and universities,. Users will work with a time-sharing hook-up with access through either teletype, typewriter, or CRT with typewriter. The Air Force is also experimenting with CAI at the Air Force Academy, the Air Force Systems Command and the Air Force Institute of Technology. (Mrs. Ester Georgatos, Office of Data Automation, Room 1D160, Pentagon, Washington, D.C. 20330, telephone OX5–9973, works with Air Force CAI projects and can supply further information.)

Educational Television

Educational or Instructional Television (ETV) has come into its own in the field of

training. Since it offers the same quality instructor and content to a large audience at a single sitting in many locations, television has helped solve the problems of too few instructors and too large a training audience to accommodate. Educational television can be aired on closed circuit systems, available only to those with a special receiver or on the readily available UHF and VHF frequencies of commercial and educational television stations. A variety of formats and classroom use of the media have been developed and successfully initiated in the classroom. Schools have experimented with fully televised classes, and classes with a televised segment at the beginning, in the middle, or at the end of the class period. These experiments have yielded a wealth of information about the efficient use of the televised class, but in general "it was found that the utilization is best when TV instruction does not take up the major part of any pupil's school day and when a TV lesson is followed as soon as possible by a session with a classroom teacher."[21]

In using television for training, two things need to be kept in mind:

1. "Television is more likely to be an efficient tool of learning if it is planned and organized efficiently."[22]
2. "Television is a mass medium; to be used efficiently, it must be used in a large way."[23]

Quality education television presentations, then, are achieved through careful systematic planning of the course content and use of available equipment combined with wide availability and use of the course. Schramm and Chu found several common problems in using television when they surveyed current research in the field; among them were:[24]

1. There is often inadequate planning for television. The lead time needed to set up the system is almost always underestimated.
2. Too little attention is given to mastering the skills of effective teaching by television.
3. Inadequate attention is given to methods and content of television teaching. There is often no time allotted for a review of curriculum and method when there is a hurry to get television into use.
4. There is too little effort to measure results. As these researchers stated, "Showing, testing, revising an instructional television program will help substitute for lack of live feedback to the teacher and make for more learning by the students."[25]
5. Systems are typically under-utilized.

With the rising interest in ETV, new systems and equipment for sending and receiving television signals are being tested. Among the new developments in transmitting televised programs is the satellite network. COMSAT and Philco-Ford are interested in establishing such a network to transmit signals from satellites in space to pre-established TV receivers. This network would provide a nation-wide system of programs which could be made available to both rural and urban schools, while providing live coverage of events of nation-wide interest. The network would have a two-fold job, then, in providing both educational and commercial broadcasts.

The Federal Communications Commission is also aiding the growth of educational television by allowing certain bands totaling 31 channels of frequency to be set aside for educational use. The newest work in this area is being done through the SHF (Super High Frequency) bands. The systems using this frequency are commonly called ITFS (Instructional Television Fixed Service) because they are a "fixed station operated by an educational organization and are used primarily for the transmission of visual and aural instruction, cultural and other types of educational materials sent to one or more fixed receiving stations."[26] ITFS is a point-to-point system for the transmission, not broadcasting, of educational programs. This means that a signal is sent from one transmitter to another and through other receivers until it reaches its most distant receiver. When it is received at a fixed station, the ITFS receiver converts the SHF waves into VHF waves which are then shown on an ordinary television receiver.

Federal Communications Commission figures indicate that there are currently 48 ITFS stations on the air and 57 new stations are being constructed. Stanford University, for example, combines both the academic and the industrial use in its program of courses which are transmitted on ITFS to many industrial centers in

the greater Bay area. Cleveland has an educational-industrial cooperative council whose mission is to insure the productive and fair use of 16 available channels to 40 prospective users.

With its capability to administer the same quality program to a large number of students, ETV is being widely used in Government. The Social Security Administration uses a closed circuit video-tape playback system in their instructor and interviewing training because of the large demand for these courses. In both areas, television allows students to conduct interviews or simulated training lectures and see how they look in action. A course in specialized disabilities is also offered on television. A team of doctors developed and recorded the program which is used to train employees who must classify and assess disability claims.

The biggest advantages of this program are that it offers a uniform course to all students and it does not require an instructor to offer essentially the same course repeatedly. His time is free for other courses.

The Food and Drug Administration has a similar closed circuit television set-up which is intended to be used as a nationwide hook-up for all of FDA's training facilities. Eventually the hook-up will be used not only for Food and Drug employees but also for the training of state and local officials involved in the administration of various Food and Drug laws. (The Training Officer working most closely with Food and Drug's television system is Jack Markowitz, Training Division, Room 104, Crystal Plaza 5, Arlington, Virginia 22202, telephone 557–3161.)

The Agency for International Development has recently installed a closed circuit television system for its headquarters training and, like FDA, intends to hook the central system into a nation-wide system of televised training programs. (Mr. Ray Dinken, AID Office of Personnel and Manpower, Thomas Circle Building, 1121 Vermont Avenue, Room 408, Washington, D.C. 20523, is AID's initial contact for its CCTV activities.)

The IRS National Training Center has been using a closed circuit TV for their Revenue Officer interview training, and to administer segments of other courses.

The Veterans Administration has used TV in its nurse training in several hospitals to administer specialized courses which must be uniform in quality and content.

The Civil Service Commission recently used educational television in a new non-government training program. The course, "From Nine to Five", is designed to teach the behavioral aspects of secretarial practice to girls in the GS–2 to GS–7 grade levels. The class sessions are comprised of an hour and a half of class discussion and one half-hour of television. The course is aired on a Washington, D.C. UHF commercial station, WETA, Channel 26. Course materials were written by a committee of agencies in the Washington area, and reviewed by the WETA and Civil Service Commission's Bureau of Training staff. Other courses using the same format are planned. (Wayne Coy at WETA—Channel 26, 4th Street, N.W., Washington, D.C. 20001, can supply more detailed information about "From Nine to Five" and future courses.)

The Department of Defense is the largest Federal user of educational television, with all services participating in the development of televised courses or course segments. Television is used in instructor training in training centers in all the services. Laboratory sequences in technical courses are also used widely in instances when a demonstration is required which cannot be easily repeated or is difficult for a class to properly observe. In such cases, television offers the instructor freedom from conducting the experiment repeatedly for small groups of students and allows each student an unobstructed view of techniques and equipment.

Simulation

The last component of the new technology to be discussed here is simulation. This technique involves artificially creating a situation in which the student must act to solve a problem. These situations can vary in complexity and in the props required to create them. The situation created is one of role-playing where the student is told to place himself in the position of another person and is then given situations to act out as if he were that other person.

Simulation or gaming teaches a student by having him perform, by having him do. In grade schools, simulation is used to teach his-

tory, for example and students assume the roles of historical characters and the instructor introduces problems, such as religious or political factors, into the game. Students thereby gain an understanding of the pressures on these characters which influenced their decisions, which, in turn, influenced the history the students are studying.

In colleges and universities, simulations are used in many courses from business law to elementary education. Students, through the roles they assume in the class, gain perception of the real situation which they cannot gain through reading about the subject.

The implications for simulation in industry and business are in the areas of managerial and supervisory training and interviewing and counseling techniques. Simulation has also been used successfully in several more specific areas.

For example, the Federal Aviation Administration uses simulation to train air traffic controllers in the handling of departing and landing air craft in the Nation's airports. In previous training efforts for this group, the FAA used on-the-job training and experienced traffic controllers were required to teach new men the procedures and the idiosyncracies of a particular airport. With the increase in air traffic, this method of training was no longer feasible. Experienced controllers had no time for training new men, and, as a result, it was often many months before a man was qualified to act as controller. The new facility near Atlantic City, New Jersey simulates the controllers environment in the airport. The trainee has been assigned to a particular airport when he arrives at the controller's school. The airport to which he is assigned is simulated for him by the facility through a computer and visual aids, such as maps and charts. The instructors feed various landing and departure patterns and situations into the computer which provides data on the student's instrument panel. Problems are handled by the student on the same type of equipment he will use at the airport. He learns, then, to work with his future area without actually being on-site. The FAA has found that the use of simulation has decreased training time by as much as 50 percent and that trainees have little difficulty moving from the simulated to the real environment. Experienced controllers note that trainees are qualified to work with planes and equipment with a minimum of orientation on-site.

The Army and Air Force have been using computer assisted simulation for several years in various training programs. One of the first uses for simulation was in pilot training. In the pilot training course, student pilots "fly" a plane by using a fully equipped mock-up cockpit. A computer sets up situations on the mock-up instruments with which a student must deal. Through maneuvering the aircraft's instruments, a student can work with the computer to simulate all aspects of a flight from take-off to landing. The Army and Air Force also use computer assisted simulation in their training for radar technicians. Students work with a radar scope onto which a computer feeds various information and images. Students must determine if the object on the screen is a UFO, a missile, or enemy or friendly aircraft. In this training, as in pilot training, students can learn from an error by having a crash landing or a flameout, in the case of pilots, or allowing an enemy missile through lines of defense, in the case of radarmen. (For contact, see page 13.)

The Navy conducted a unique course involving simulation in one of its operation and maintenance of equipment courses. The equipment was a modified radar set-up which was not available for use by students during the training period. Mock-ups of the equipment were not available and there was not adequate time to prepare them. Students learned to use the equipment through a pure simulation. They never saw or worked with it during the training period. The entire course was administered by a paper and pencil programmed text. In addition the course was conducted on board two ships patrolling at sea. The captains of the ships allowed the equipment to be used only on the final qualifying test, and "Although self-study was entirely hands-off (no on-equipment exercises were possible), final qualification was based exclusively on on-equipment performance testing. The mean percentage score of all qualification tests was 93 percent and 100 percent of the students tested achieved both course objectives."[28] (For contact see page 12.)

Other Visual Aids

Before considering newer and exotic training devices, the training officer should be reminded that, in addition to such audio-visual aids as educational television, there are several "old standbys" which should not be overlooked in choosing training aids and methods. These are films, slides, filmstrips, and vu-graph presentations. Some teaching machine systems, such as EDEX, make use of these aids to administer parts of programmed courses, and without exception Federal agencies employ them in training programs. Although they are simple and have been used for a long time, they are valuable training aids. Using them, however, requires the same cautions as using a teaching machine, because "the media merely make information available, they do not teach".[27]

Films and other visual aids can easily and effectively be used in the classroom if discretion is used in choosing an aid directly related to the course study; an aid used as an essential sequence of information and not used as a "filler" to bring a course to desired length.

The Department of Defense has been using training films in its basic and advanced training courses for many years, and the General Services Administration has found films a convenient and effective way to teach its Wage Board Employees the various tasks they will perform in their jobs. All other agencies have also employed films and slides in training programs at one time or another.

Summary

This paper has defined the systems approach to training as a method of course development in which measurable objectives are specifically defined, the system is viewed as responsible for teaching students, and the evaluation is conducted to determine the adequacy of the entire system, not to determine the level of achievement reached by students.

It has described various teaching media and cautioned the reader against their "promiscuous use" in training programs. It has stressed that media should be used as training aids, worked into a course after course objectives and content have been established. A film, for example, should only be used if it provides the most effective method for teaching students a segment of the course material. Likewise, a teaching machine should only be employed if it is found to be more effective than any other method, for example, more effective than a paper and pencil program of the same material.

Although there are many examples of sophisticated uses of training approaches and media included here, the reader is cautioned that they represent a minor part of the Federal training scope. The development of new approaches and the acquisition of new equipment are both costly and time consuming. Many agencies have neither the time nor the staff for development of this type of training program. Agencies who have the resources available are able to participate only on a limited scale, and only a partial listing of their efforts are mentioned here. The examples, however, indicate that changes are being made and that new techniques are highly successful.

Footnotes

[1] Naval Training Device Center, *Automated Teaching: A Review of Theory and Research* (Port Washington, New York, 1960), p. 34.

[2] Office of Economic Opportunity, *Instructional Systems Development Manual* (Washington, D.C., 1968), p. 37.

[3] Wilbur Schramm, *Programmed Instruction* (New York), p. 1.

[4] Albert A. Canfield, "Instructional Systems Development", *Educational Screen and Audiovisual Guide* (June 1967).

[5] Robert F. Mager, *Preparing Instructional Objectives* (Palo Alto, California, 1962), p. 3.

[6] Office of Economic Opportunity, p. 68.

[7] Mager, *Preparing Instructional Objectives*, p. 52.

[8] Ibid, p. 3.

[9] Office of Economic Opportunity, p. 131.

[10] The Federal Bureau of Investigation will continue to train its men in its own facilities.

[11] Army Security Agency, *The Development of Instructional Systems* (Fort Devens, Mass., 1966), p. 3.

[12] Bureau of Naval Personnel, *Catalogue of Programmed Instructional Material* (Washington, D.C., 1967), Sec. III, p. 5.

[13] Schramm, p. 2.

[14] Thomas F. Gilbert, "On the Relevance of Laboratory Investigation of Learning to Self-Instructional Programming", *Teaching Machines and Programmed Learning*, ed. A. A. Lumsdaine and Robert Glaser (Washington, D.C., 1961), p. 478.

[15] Office of Economic Opportunity, p. 107.

[16] Naval Training Device Center, p. 29.

[17] W. J. Carr, "A Functional Analysis of Self-Instructional Devices", *Teaching Machines and Programmed Learning*, p. 542.

[18] A. A. Lumsdaine, "Teaching Machines: An Introductory Overview", *Teaching Machines and Programmed Learning*, p. 5.

[19] Office of Economic Opportunity, p. 107.

[20] Systems Development Corporation, *Time Sharing* (Santa Monica, California, 1967), p. 1.

[21] Thomas M. Rienzi, "Audio Visual Impact on Training Innovations at the U.S. Army Signal Center and School", Project ARISTOTLE (Washington, D.C., 1967), p. 389.

[22] Kurt Rothchild, "Educational Television", Project ARISTOTLE, p. 84.

[23] Godwin Chu and Wilbur Schramm, Learning from Television: *What the Research Says* (Stanford, California, 1967), p. 35.

[24] Ibid., p. 33.

[25] Ibid, p. 35.

[26] Ibid, p. 90.

[27] Bernarr Cooper, ed., *ITFS: What It Is . . . How to Plan* (Washington, D.C. 1967), p. 8.

[28] Sperry Rand Gyroscope Division, *Validation Report for Shipboard Self-Study of Ordalt Operation and Maintenance* (Great Neck, New York, 1968), p. 19.

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